

## CLAIMS

What is claimed is:

1. A tunable Fabry-Perot filter, comprising:
  - 2 a pair of opposed, at least partially reflective surfaces defining an optical cavity; and
  - 4 a nano-dispersion of liquid crystals disposed in said cavity.
2. The filter according to claim 1, wherein said liquid crystals are disposed in
  - 2 an array in a metal-oxide matrix.
3. The filter according to claim 1, wherein said liquid crystals are disposed in
  - 2 an array of holes in a metal-oxide matrix.
4. The filter according to claim 1, wherein said liquid crystals are disposed in
  - 2 an array of holes in a metal-oxide matrix, the metal oxide being taken from the group consisting of  $\text{TiO}_2$ ,  $\text{SiO}_2$  and  $\text{ZiO}_2$ .
5. The filter according to claim 3, wherein said metal-oxide matrix is  $\text{TiO}_2$ .
6. The filter according to claim 1, wherein said liquid crystals are disposed in
  - 2 an irregular array of generally spherical holes in a metal-oxide matrix.

7. The filter according to claim 6, wherein said holes are on the order of about  
2 10 to 50 nm in diameter.

8. The filter according to claim 6, wherein said holes make up at least fifty  
2 percent of the volume of said matrix.

9. The filter according to claim 6, wherein said holes make up no more than  
2 about sixty-eight percent of the volume of said matrix.

10. The filter according to claim 6, wherein said holes make up from about  
2 fifty percent to about sixty-eighty percent of the volume of said matrix.

11. The filter according to claim 1, wherein said liquid crystals are in droplet  
2 form, said droplets being smaller than the optical wavelengths to be passed through  
the filter.

12. The filter according to claim 1, and further comprising means for applying  
2 an electric field to said liquid crystals.

13. The filter according to claim 12, wherein the optical wavelengths which  
2 the filter passes are tunable by varying the electric field applied across said optical  
cavity.

14. A tunable Fabry-Perot filter, comprising:

2 a pair of opposed, at least partially reflective, generally parallel surfaces  
defining a cavity; and

4 a nano-dispersion of liquid crystals disposed in an array in a metal-oxide  
matrix in said cavity.

15. The filter according to claim 14, wherein said liquid crystals are disposed

2 in an array of substantially spherical holes in said metal-oxide matrix.

16. The filter according to claim 14, wherein said holes are on the order of

2 about 10 to 50 nm in diameter and make up from about fifty percent to about sixty-  
eighty percent of the volume of said matrix.

17. The filter according to claim 15, wherein said metal-oxide matrix is

2 formed of metal oxides taken from the group consisting of  $\text{TiO}_2$ ,  $\text{SiO}_2$  and  $\text{ZiO}_2$ .

18. The filter according to claim 14, wherein said liquid crystals are in droplet

2 form, said droplets being smaller than the optical wavelengths to be passed through  
the filter.

19. The filter according to claim 15, and further comprising means for

2 applying an electric field to said liquid crystals.

20. The filter according to claim 19, wherein the optical wavelengths which  
2 the filter passes are tunable by varying the electric field applied across said cavity  
containing said liquid crystals.

21. A method of making tunable Fabry-Perot filter, comprising the steps of:  
2 providing a pair of opposed, at least partially reflective, generally parallel  
surfaces;  
4 positioning said at least partially reflective surfaces to define a cavity  
therebetween; and  
6 placing a nano-dispersion of liquid crystals disposed in an irregular array in a  
metal-oxide matrix in said cavity.

22. The method according to claim 21, wherein the liquid crystals are disposed  
2 in an array of substantially spherical holes in a metal-oxide matrix.

23. The method according to claim 22, wherein the holes are on the order of  
2 about 10 to 50 nm in diameter and make up from about fifty percent to about sixty-  
eight percent of the volume of the matrix.

24. The method according to claim 21, wherein the matrix is formed of a metal  
2 oxide taken from the group consisting of  $\text{TiO}_2$ ,  $\text{SiO}_2$  and  $\text{ZiO}_2$ .

25. The method according to claim 21, wherein formation of the metal-oxide  
2 matrix comprises of the steps of:  
selecting a quantity of polymer balls having a predetermined size;

selecting a quantity of particles of metal oxide having a predetermined size;  
2 mixing the polymer balls with the particles of titanium oxide;  
placing the mixture within a form;  
4 applying sufficient heat to the mixture in the form to burn off the polymer  
balls and fuse the metal oxide, thereby forming a matrix of generally spherical  
6 holes; and  
introducing liquid crystal into the holes in the matrix.

26. The method according to claim 25, wherein the liquid crystal is introduced  
2 into the matrix by means of a vacuum.

27. The method according to claim 25, wherein the metal oxide is taken from  
2 the group consisting of  $\text{TiO}_2$ ,  $\text{SiO}_2$  and  $\text{ZrO}_2$ .

28. The method according to claim 21, wherein the liquid crystals are in  
2 droplet form, said droplets being smaller than the optical wavelengths to be passed  
through the filter.

29. The method according to claim 21, and comprising the further step of  
2 providing means for applying an electric field across the cavity.

30. The method according to claim 29, wherein the optical wavelengths which  
2 the filter passes are tunable by varying the electric field applied across the liquid  
crystal cavity.

31. A method of using a tunable Fabry-Perot filter to selectively pass optical  
2 frequencies therethrough, the filter being formed of a cavity defined by at least  
partially reflective, generally parallel, spaced surfaces, with a metal-oxide matrix  
4 having an irregular array of holes therein filled with liquid crystal material, the  
method comprising:  
6       injecting optical signals into the tunable filter; and  
      applying a controllable electric field across the filter to tune the resonant  
8 frequency of the cavity to thereby pass optical signals having selected frequencies.

32. The method according to claim 31, wherein the resonant frequency of the  
2 liquid crystal cavity is varied by changing the refractive index of the liquid crystals  
therein in response to the electric field applied across the filter.